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Apr 28th, 8:00 AM

## Panel Session I - Facilities and Ground Support Equipment for Space Power Satellites, Moon and Mars

Joseph A. Brown

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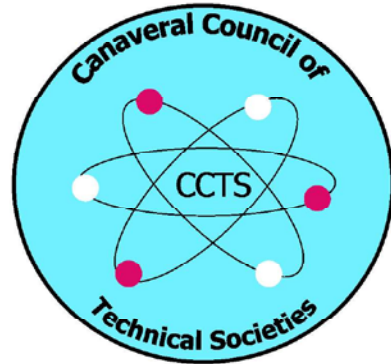
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# **SPACE VISIONS CONGRESS 2007**

## **PANEL SESSION 2**

**“FACILITIES AND GROUND SUPPORT EQUIPMENT  
FOR SPACE POWER SATELLITES, MOON AND MARS”**

**JOE BROWN**



A photograph of a Space Shuttle launching from the launch pad, with a large plume of smoke and fire. The image is partially obscured by a large, semi-transparent yellow graphic that resembles a stylized 'S' or a comet tail, which serves as a background for the text.

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# ***Facilities and Ground Support Equipment for Space Power Satellites, Moon and Mars***

***For Space Vision Congress,  
Florida Solar Center  
April 26-28, 2007***

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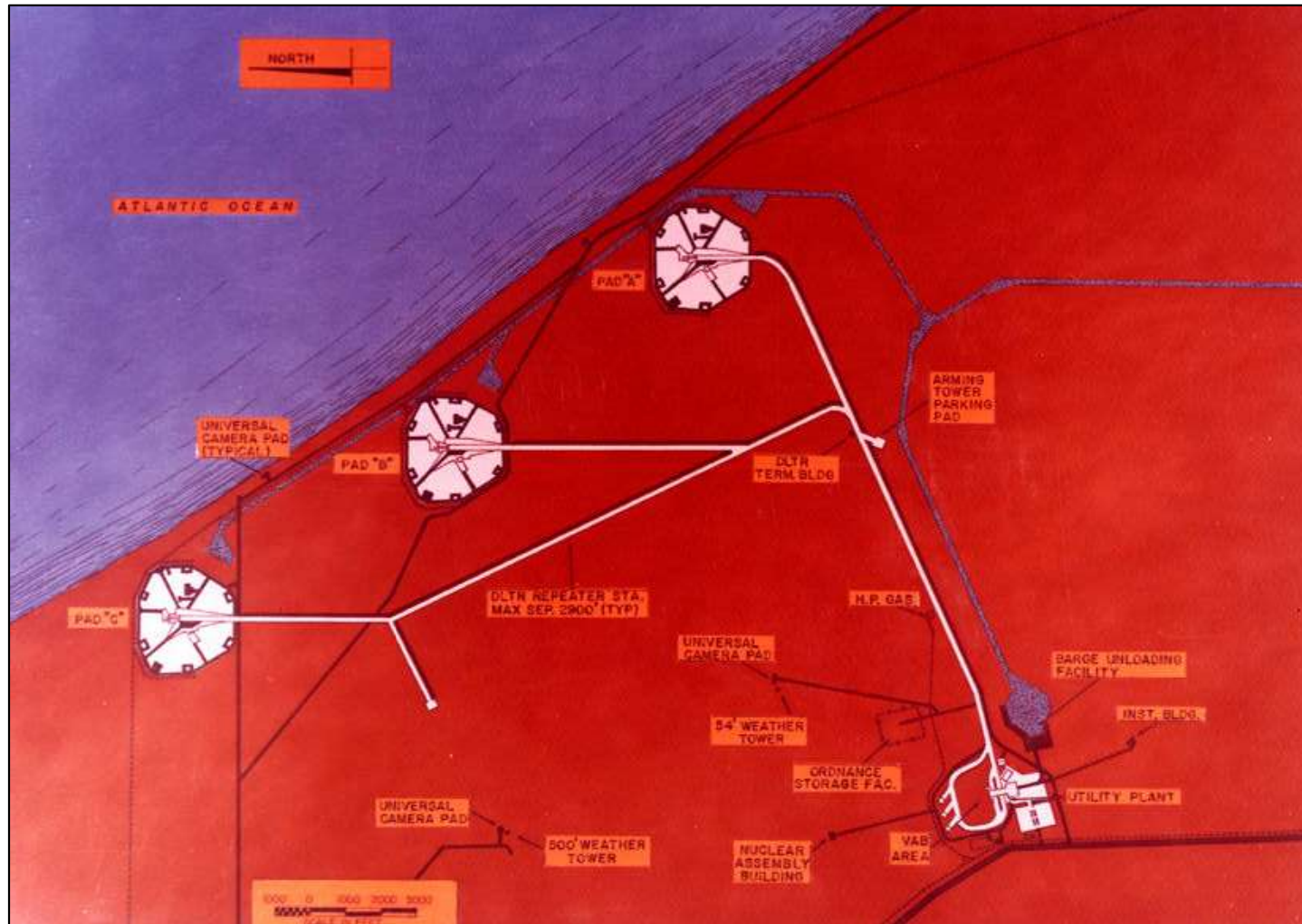
# Facilities & Ground Support Equipment (GSE)

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- Some KSC facilities are LC-39 Launch Area including:
  - VAB, new ½ - full cost dollars \$1-3 Billion – time 5-8 years
  - LCC, refurb
  - OPF's,
  - two launch pads, new cost “QROME” \$1-2 Billion – time 3-6 years
  - support buildings,
  - crawler transporters,
  - three launch platforms “MLP's”,
    - may require 3-6 more for Solar Electrical Satellite
  - crawl-away,
  - park sites,
  - SSPF, O&C, RPSF, VPF, LETF, GSE (items used to transport, access, handle, protect, service, and check-out flight hardware/software on the ground such as; RSS, platforms, panels, ECS Systems, cranes, hoists, lifting devices, and auto couplers)

See JAB Website [www.lobiddervideo.com](http://www.lobiddervideo.com), Estimating Tools for pictures of GSE and facilities, also see JAB Vols. 14 and 15, pgs. 18-26, and 96-99. Also see website Searchable Vol. 18

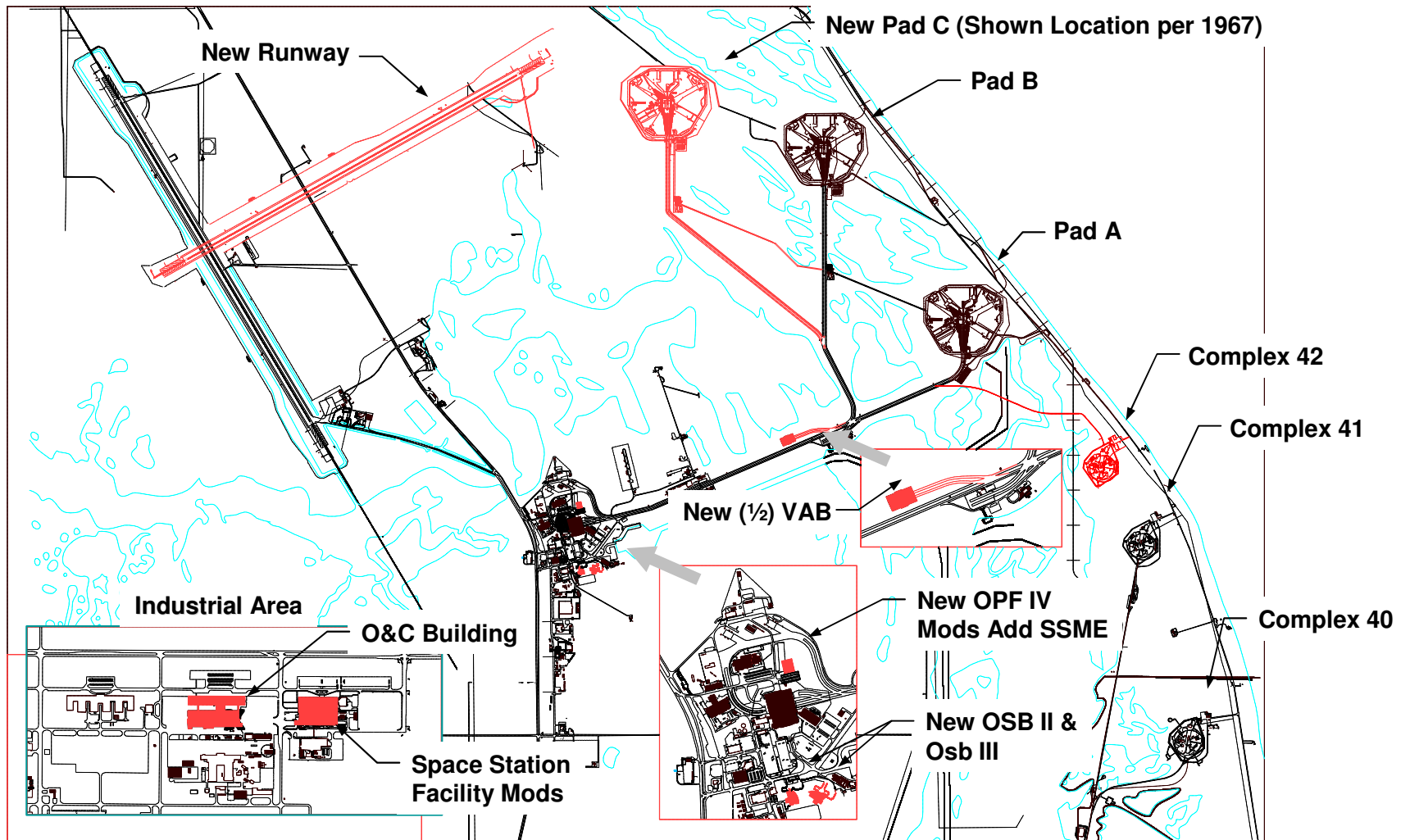
# Pads 'A' & 'B' and Proposed Pad 'C' – Background LC-39 Overview



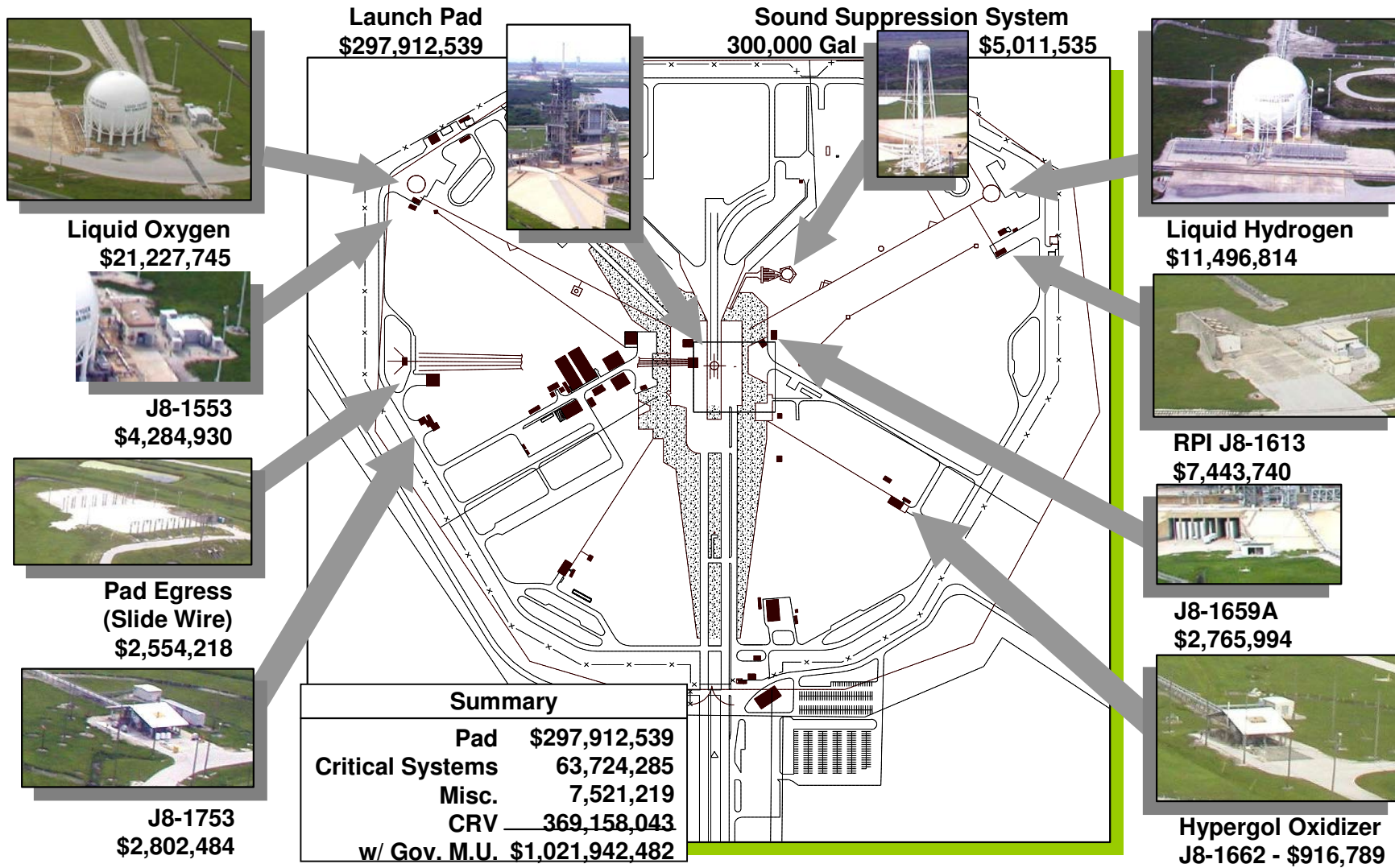
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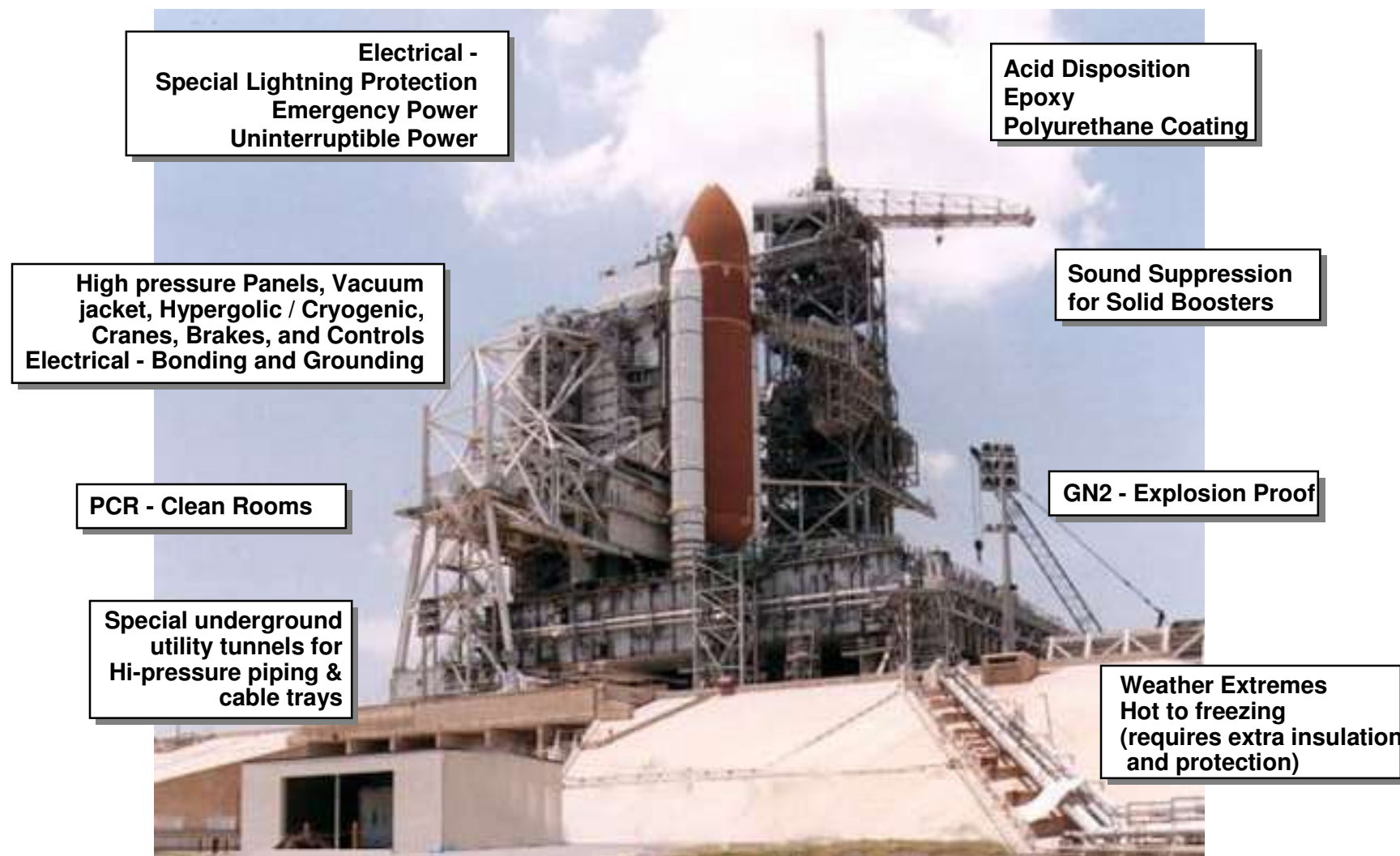
# Site Map / Overview – Proposed New Pads / Facilities



# Launch Complex 39 – Pad A

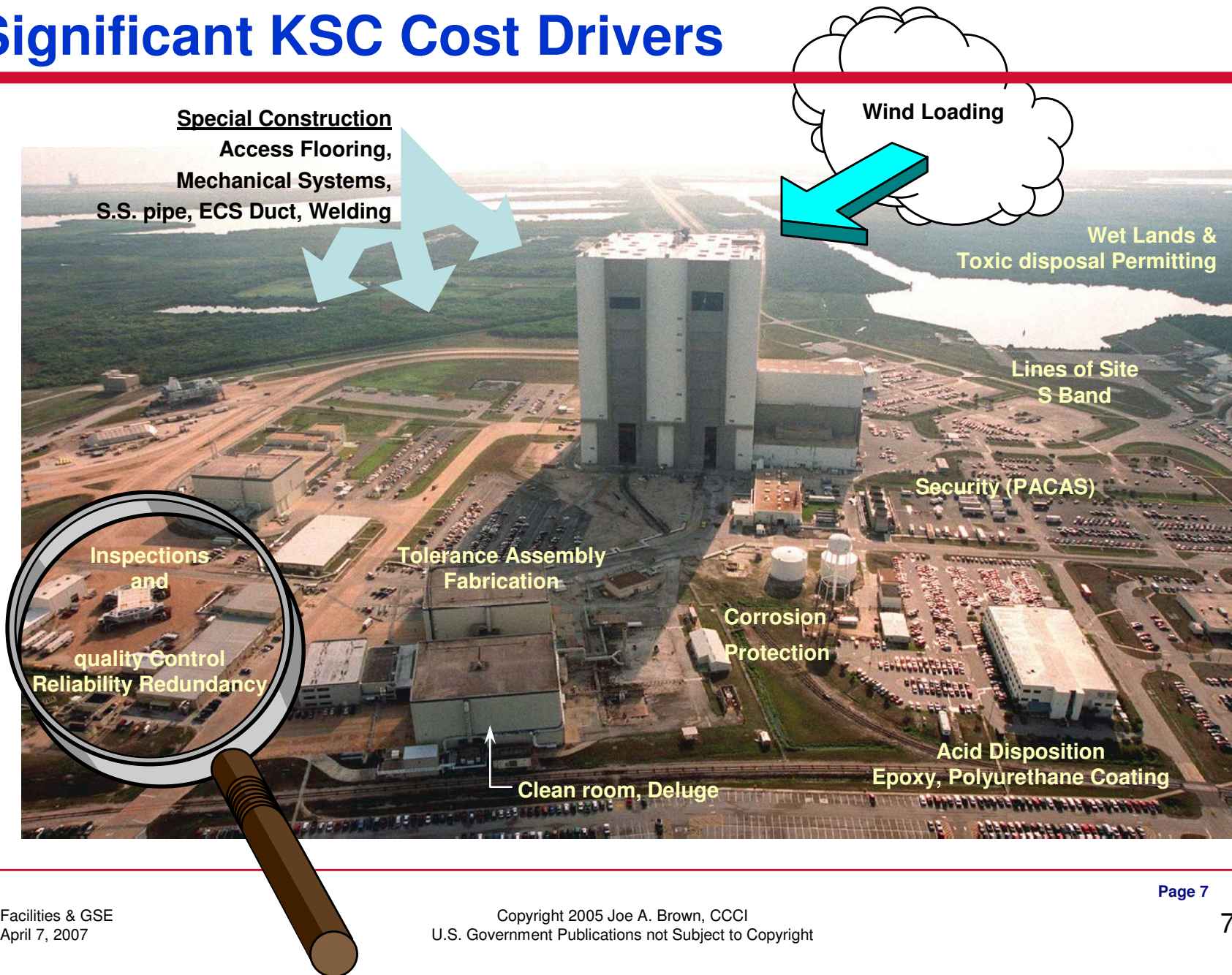


# Significant KSC Cost Drivers





# Significant KSC Cost Drivers





# VAB Interior Concept Illustration

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## Out Fitting High Bay #2

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# Suspended Concrete Slab Forming – 520 Feet

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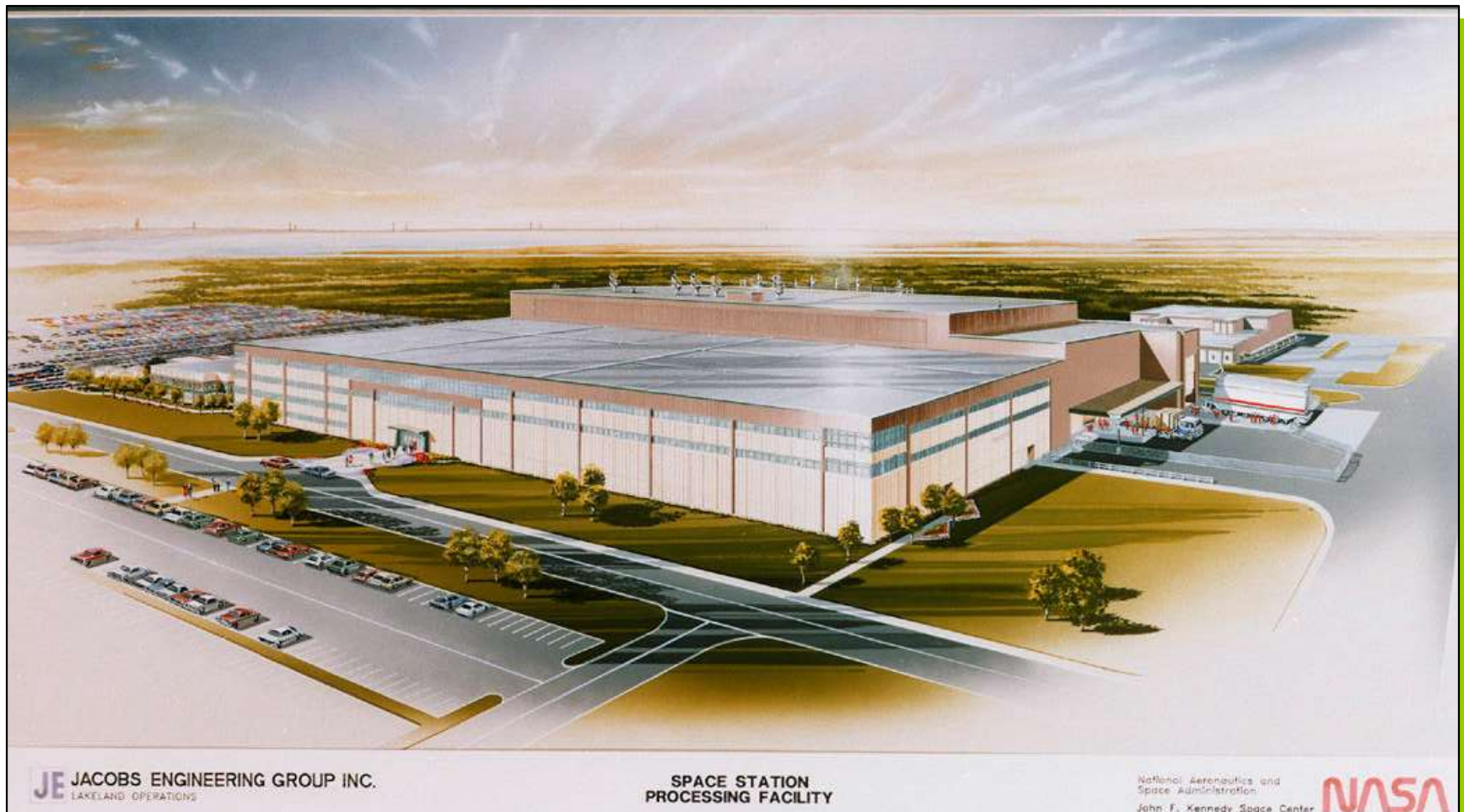
# Orbiter Processing Facility

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- Orbiter Processing Facility – Phase 1
- Way #67 Special sub-contractor team work – (a “closed shop” team work effort helped them win this bid). Project Manager for Briscoe later confirmed this was a money maker for them (see system summary)



# Artist Rendering – SSPF Space Station Processing Facility, also for Constellation



April 7, 2007

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## SRB Facility – Under Budget on Schedule (cont'd)

# SRB Facility – Under Budget on Schedule





# What is GSE? As Shown in KSC-STA-67, Rev. A 6/19/90

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- **Ground Support Equipment (GSE)**
  - Items or units used to transport, access, handle, protect, service, or checkout flight hardware/software on the ground
- **Ground Support Equipment Item Description (GSEID)**
  - The GSEID defines and describes the physical and functional characteristics of the system / subsystem / equipment to be design, developed, procured, fabricated / assembled, tested, checkout and used
  - All interfaces with other systems and equipment, flight and ground, are identified
  - Performance requirements are included and verification testing identified
- **KSC SPEC G-0003 July 5, 1977**
  - Further GSE function designations (TR 1287)
    - Servicing
    - Checkout & Test
    - Handling & Transportation
    - Auxiliary
    - Uncategorized

# Examples of GSE: CCS

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- **Computer Control Systems (CLCS),**
- **Hardware: Computer processing unit, printers, display monitors storage devices**
- **Software: Programs – “People Soft”, “Magnum”, KIMS**
- **Training: Video Instruction**
- **Electronic / Electrical: Cabling, Control, Sensors, Racks, Solenoids, Motors, Power, Communication, Instrumentation, and Video Cameras**



## Examples of GSE: ECS

- Environmental Control Systems, Portable ECS Units HEPA Filters, Clean Room, Equipment Pumps, Compressors SS Double Wall Ducts, and ECLSS



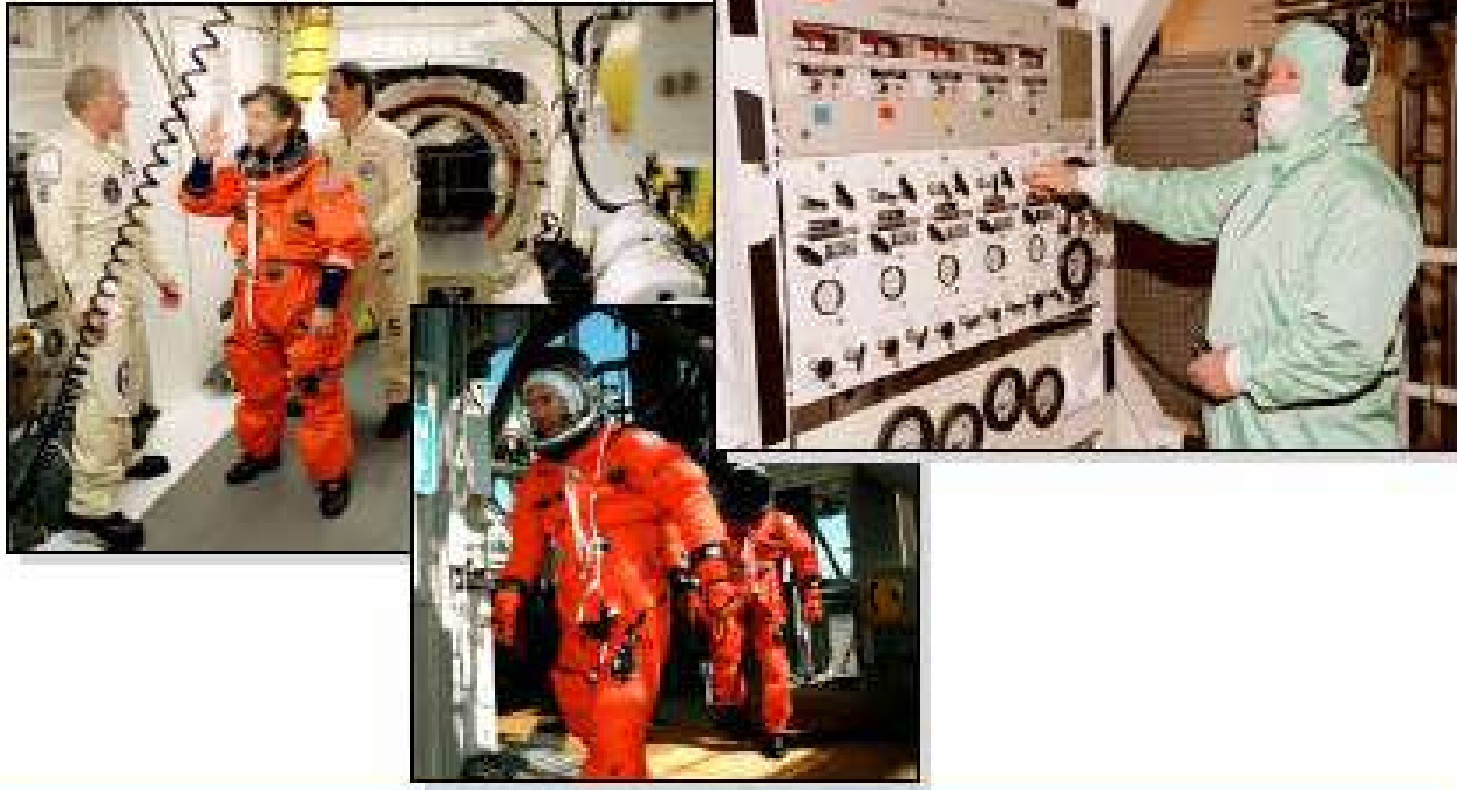
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## Example of GSE: Panels

- GHe, GN2, and Breathing Air



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## Examples of GSE: Piping

- Vacuum Jacket, High pressure, Tubing, Flexible hoses, and Double wall stainless



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## Examples of GSE: Architectural

- Environmental Enclosure on end of Swing Arm Canisters



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## Examples of GSE: Machinery

- Rotating Swing Arms, Cranes Hoist, Lifting Devices and Transporters



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F  
April 1, 2004

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## Examples of GSE: Structural – KSC Shuttle GSE

- OPF, VAB PCR / RSS, FST Aft Platforms, and Orbiter Access Platforms



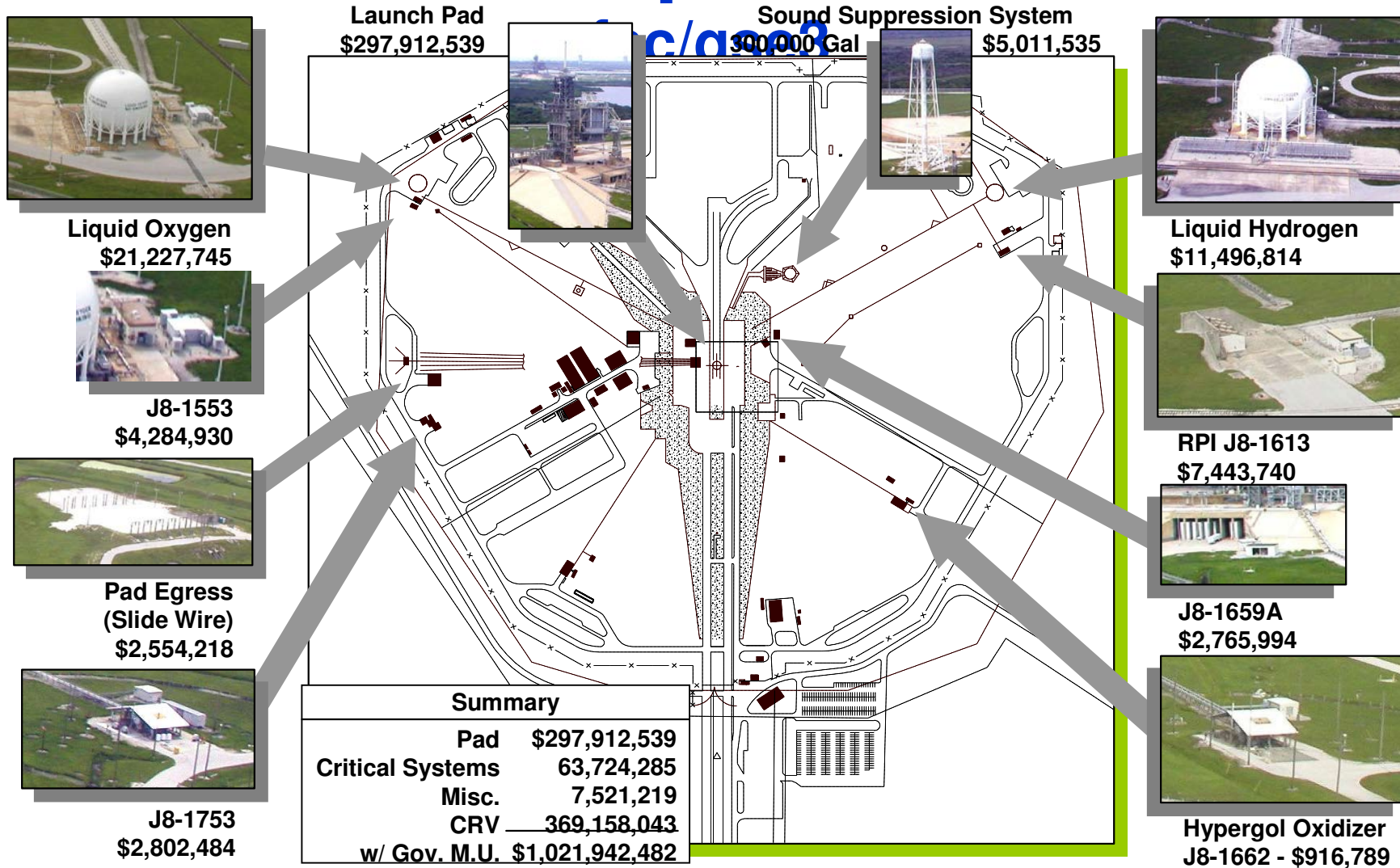
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# Launch Complex 39 – Pad A



# OSB Project System Summary/Estimating Tool/Facility

SYSTEM SUMMARY OF DETAILED COMBINED FUND ESTIMATE															SHEET _____ OF _____					
DRAWING NO. 79K35697			SHEETS			LOCATION NASA KENNEDY SPACE CENTER, LC39			PROJECT OPERATIONS SUPPORT BUILDING #2			CODE C-95 DETAILED ESTIMATE SUBMITTED DATE 05/15/03								
WORK ORDER/CONTRACT NAS10-00031(B)/DO-3			ARCHITECT/ENGINEER WOLFBERG ALVAREZ			ESTIMATOR JAB/PAK ADJUSTED			CHECKER			DESCRIPTION								
CONSTRUCTION COSTS												SCOPE			BASIC PLAN			COMMENTS		
DIV. TITLE	QTY	UNIT	\$/UNIT	\$/BSF	TOTAL	DIV. TOTAL	DIV. TITLE	QTY	UNIT	\$/UNIT	\$/BSF	TOTAL	DIV. TOTAL	(CIRCLE ONE)	(CIRCLE ONE)					
1. GNL. COND.	\$ 1,788,965	BSF	9.42	-			9. FINISHES				16.62		\$ 3,156,918	1. FAIR	A. SQUARE	Recession				
1.A Special Conditions	\$ 297,583	BSF	1.57				Plaster & Gyp Board	220538	SF	6.92	8.03	1,525,136		2. AVERAGE	B. RECTANGULAR	Great Bids				
1B. Indirect & Reserves	\$ 1,280,886	BSF	6.74	NOT INCLUDED			Flooring	68376	SF	4.84	1.74	330,815		3. GOOD	C. IRREGULAR	General Conditions too high				
1C. Fees on GC & Indirect	\$ 153,493	BSF	0.81				Interior Paint	226710	SF	0.72	0.86	163,178		4. COMPLEX	D. VERY IRREGULAR	HUB Zone: Historically Under				
1D. Escalation	\$ 931,819	BSF	4.90				Acoustical Tile	184000	SF	3.29	3.18	604,789		5. SOPHISTICATED	E. CURVED ON NE FAC	Utilized Business Zone				
							Floor Sealer	11592	SF	0.57	0.03	6,617		DESIGN DATA						
							Metal Cladding	6390	SF	30	1.02	192,907		BLDG. TYPE: Steel frame, precast concrete panels and window band_						
2. SITE WORK				26.13		\$ 4,965,606	Flooring- Carpet	12576	SY	27	1.76	333,475		CAPACITY: 1000 people_						
Demolition- Complexes	194,000	SF	1.66	1.69	321,988		10. SPECIALTIES				0.42		\$ 79,146	STRUC. FRAME: Structural Steel_						
Earthwork/Fill	1,575	CY	618.29	5.13	973,810		Toilet Compartments	53	EA	643	0.18	34,096		EXTERIOR WALL: Precast Panels with Window Bands_						
Utilities	6,667	LF	109.75	3.85	731,689		Fire Cabinets & Extinguishers	40	EA	278	0.06	11,118		HEIGHT: 95'-3"						
Paving	8,827	SY	13.72	0.64	121,117	Note #1	Bathroom Accessories	126	EA	112	0.07	14,110		GROUND FLOOR AREA: 41,000_ SF.						
Landscape	122,000	SF	4.83	3.10	588,748		Lockers	36	EA	213	0.04	7,663		TOTAL FLOOR AREA: 190,000_ SF.						
Drainage	695	LF	2,359	8.63	1,639,506		Loading Dock Equipment	1	EA	7,712	0.04	7,712		VOLUME: 2,873,200_ CF.						
Bored Piles	27468	VL	21.43	3.10	588,748		Telephone Enclosures	16	EA	278	0.02	4,447		PERCENT AIR CONDITIONED: 100% 703 TONS PER DRAWING - NO CHILLER						
3A. CONCRETE	10220	CY	296	15.92		\$ 3,023,981	11. EQUIPMENT				-		\$ -	OTHER: Ammendment #5 Set Aside Award Problem - HUB Zone						
Formwork	52626	SFCA	9.08	2.51	477,654		12. FURNISHINGS				-		\$ -	SPECIAL FEATURES						
Rebar	384.4	TONS	2,533	5.13	973,810		Modular Furniture, Grnd, 3rd, 4th	355	WS	4,375	Not Included		\$ -	Monumental Design, 5th floor mission briefing room with observation deck for launch						
Concrete	7356	CY	99	3.85	731,689		Roll Up Shades	1	Lot	2,116			\$ -	and landing. Low bidders withdrew due to delay in award & HUB Zone Set Aside						
High strength Concrete	2864	CY	190	2.86	543,358		13. SPECIAL CONSTR.				0.29		\$ 54,946	CONSTRUCTION BID DATA (IFB 10-02-001)						
Finish Slabs	189853	SF	1.57	1.57	297,470		Hazardous Material Abatement				0.29		\$ 54,946	TOTAL BLDG. SF: 190,000						
3B. CONCRETE PANELS				5.26		\$ 998,520	14. CONVEYING SYS.				2.68		\$ 508,913	ARCH/STRUC: 72.62 /BSF \$ 13,796,570						
Pre-Cast Panels	66568	SF	15.00	5.26	998,520	Note #2	Elevators	4	EA	122,854	2.55	490,618		INTERIOR MECH: 15.50 /BSF \$ 2,944,816						
4. MASONRY				0.09		\$ 17,928	Handicapped Lift	1	EA	18,295	0.10	18,295		INTERIOR ELEC: 18.84 /BSF \$ 3,579,623						
Block	2980	SF	6.02	0.09	17,928		15. MECHANICAL				15.50		\$ 2,944,816	TOTAL INTERIOR: 106.96 /BSF \$ 20,320,008						
5. METALS	1393	TON	1,973	14.47		\$ 2,748,376	PLUMBING	142	FIXT	5,070	3.79	719,963		TOTAL EXTERIOR: 26.13 /BSF \$ 4,965,606						
Structural Steel	1393	TON	1,568	11.50	2,184,568		Fire Supresion / Sprinkler	1900	HDS	187	1.87	354,840		TOTAL CONSTR: 133.10 /BSF \$ 25,288,614						
MISC Metals				1.40	265,533		HVAC	703	TONS	2,660	9.84	1,870,013		OPTIONS						
Floor & Roof Decking	154058	SF	1.94	1.57	298,274		16. ELECTRICAL				18.84		\$ 3,579,623	CONDITIONS						
6. WOOD/PLASTICS				0.24		\$ 45,065	Conductors, Cables	9901	CLF	56	2.91	553,686		TOTAL PROJECT EST: 139.46 /BSF \$ 26,497,341						
Carpentry				0.24	45,065		Conduit	1738	CLF	423	0.16	29,452		BID DATE: 7/10/02						
7. MOISTURE PROTECT.				6.93		\$ 1,316,217	Exterior Electrical				1.25		\$ 237,500	AWARDED TO: David Boland 12/24/02						
Built Up Roofing	390	SQ	973	2.00	379,656		Fire Detection & Alarm	190,000	SF	1.25	1.25	237,500	Note #5	CONSTRUCTION TIME SPAN: 27 MONTH 835 Calendar Days						
Waterproofing Terrace	110	SQ	1,814	1.05	199,537		Panels/Switchgear	51	EA	9,988	3.12	592,794	Note #5	NO. OF BIDDERS: 9 POSITION OF GOVT. EST. 9						
Insulation	75760	SF	0.88	0.35	66,657		Premise Wiring/Data - Voice				2.32		\$ 441,036	% DIFFERENCE, AWARD BID AND GOVT. EST. 21.0%						
Fire Proofing	152270	SF	1.57	1.26	239,171		Miscellaneous Electrical				6.36		\$ 1,208,727	Award delayed 7 months due to protest						
Caulking/Sealants				2.27	431,196		OPTIONS - AVERAGE ABSTRACT BID USED				1.53		\$ 291,334	BIDDERS						
8. DOORS & GLASS				9.73		\$ 1,848,561	#1 Fiber to desktop	1250	OUTLT	233	1.53	291,334		(LOW) Clancy & Theys, Orlando \$ 22,872,375						
Doors	305	EA	442	0.71	134,677		#2 Floor 2 Furniture	156	WS	6,072	Not Included			J. Kokolakis, Tarpon Springs \$ 23,227,300						
Exterior Glazed Curtain Wall	27242	SF	57	8.24	1,565,267		#3 MCC Outfit	294	SEAT	270				Ivey's, Merritt Island \$ 23,921,700						
Storefront Glass	240	SF	20	0.03	4,836		#4 Excess Demolition ***	4.5	CX	2	0.00	8		TO David Boland, Titusville \$ 23,969,000						
Finish Hardware	305	EA	471	0.76	143,781		#5 Parking	4300	SY	64	1.45	274,733		W&J, Rockledge \$ 24,123,420						
							#6 Switchgear				0.82	156,600		Beers Skanska, Orlando \$ 24,739,473						
							#7 Kitchen Equipment	1500	SF	167	1.32	250,099		MCS, Tampa \$ 25,245,024						
							#8 CSOC Teleconfer Sys				1.24	235,953		Rush/Mustang, San Antonio, Tx \$ 25,725,000						
							#9 Misc Furniture				4.285	Not Included	\$ -	NOT IN BID Government \$ 30,355,707						
							PROJECT TOTALS					\$ 26,497,341								


Corrected data to reflect A&E estimate  
Reflects Log Facility Cost escalated to 20002

Reduced unit cost from \$228/fixture to \$190/fixture based on OPF Annex Task III  
Reduced FA from \$4.71/SF to \$1.25/SF  
Reduced Premise Wiring cost by 50%

Note #1  
Note #2  
Note #4  
Note #5  
Note #6

JAB/PAK Adjusted Cost  
Options #2, #3, & #9 were not included in Options #2, #3, & #9 were not included in base bid  
Removed general condition costs as this is removed general condition costs as this appears to be duplicated in the base bids.  
Removed all furniture costs from basic bid  
Adjusted Option #4 Demolition to equate to basic demolition of 4 large complexes.  
CFP summary for building communication mods 3, 8, 11, & 21 were \$7.50 / BSF or 1.32 / CFP in 10/1989.  
Precast panel labor adjusted to 0.094/SF and labor at 25.21/MH; Structural Steel labor at 9MH/Ton; T&B at 700MH.

Note 3: Chilled Water from Utility Annex



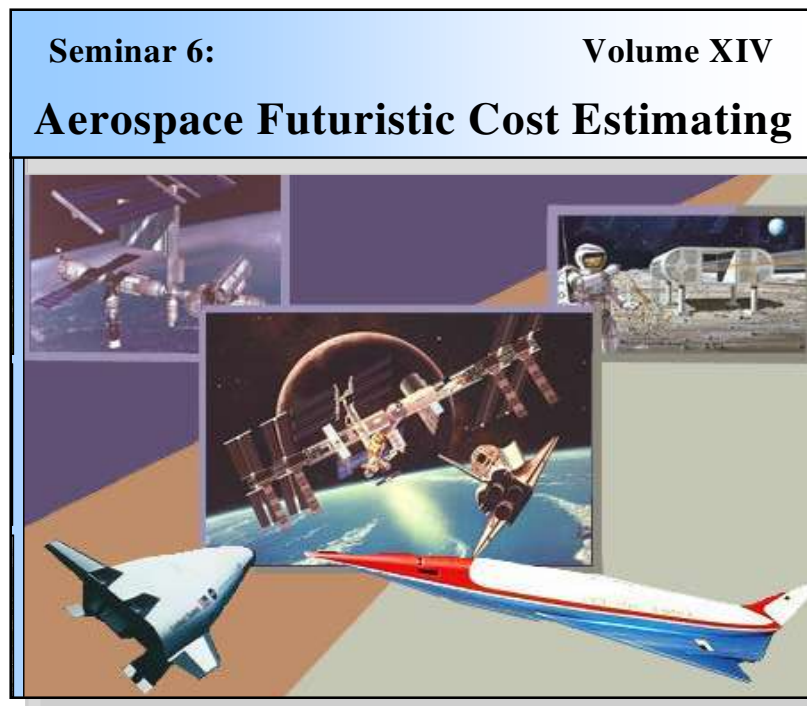
**Planned Polygenerator Facility Site North of VAB Oxygen, Hydrogen, Nitrogen, Electrical Power  
Study Nov. '83 QROME \$151 Mil, Escalated to April 2012 \$457 Mil by JAB/CCCI/Computer Prog**





# Summary

*We must continue educating the American people on the importance to the US economy, world pollution, productivity, cost engineering, and an accelerated space program for the continued success of our country.*



# Thank You!

***A Special Thank You to AACE, KSC, USA, CCCI and team members for your support.***

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